Space Weather Technical Forecast

Issued on Wednesday, 06 April 2022 at 01:14 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Minor/Moderate G1/G2 geomagnetic storm likely day 1 (6th April) from a centre-disc filament eruption on 03 April with a slight chance of a G3 Strong storm. Possible glancing blow from another CME on Day 4 (9th April).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with only a few minor C-class flares.

There are currently six sunspots on the visible disc, with four of these numbered and two unnumbered. The largest region on the disc is AR2978, which has retained a similar Ehi/Beta classification to recent days, with minor intermediate spot proliferation. To its immediate south, AR2981 has remained stable, finishing the 24 hours as a Cro/Beta. The remaining two numbered regions, AR2983 and AR2985 in the eastern hemisphere, as well as the two un-numbered regions are all unipolar, stable and unremarkable.

At 04/2113 UTC a filament eruption occurred in the south central disc, with this event visible in images such as AIA304 as well as Cerro Tololo H-Alpha amongst others. This event was tied to a C2.7 flare, and launched a CME, which has been analysed and shows an Earth-directed component, which may give a glancing blow on Day 4 (9th April).

No other Earth-directed CMEs were apparent in imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, has slowly declined probably due to waning affects from CH70, with a peak of 483km/s at 05/0645UTC, before declining to around 430km/s by end of the period. The solar wind density was within its typical average range of mid-single figures ppcc, while the IMF remained weak, peaking at 8nT. The north-south component varied between -4 and +6nT. The phi angle was mainly negative (towards the sun). The net result of the above solar wind was Quiet geomagnetic conditions (Kp1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10MeV) measured at GOES-16 showed a continuing gradual relaxation towards Background levels, having reached S1/Minor Storm on 02 April, in the wake of an M-class flare from the northwest limb.

The high energy (greater than 2MeV) electron flux as observed by GOES-16 at GEO showed an increased-amplitude diurnal oscillation between Normal Background and High flux, peaking at 2903 pfu at 05/1625 UTC. The 24-hour integrated fluence showed a steady rising trend to just above the Active fluence threshold, with an integrated 1.13e8 pfu recorded at 06/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity should be predominantly Low, with relatively fewer and less complex active regions on the visible disc than of late.

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Met Office Space Weather Technical Forecast

Solar Wind / Geomagnetic Activity: Earth is currently exiting from a high speed stream from CH70/+, which has now rotated off the visible disc. The next coronal hole (CH72) will possibly become geoeffective by Day 4 (9th April), combined with the arrival of the CME from the filament eruption on the 4th April.

There are currently two CMEs in the forecast at present.

The first CME is that from the 03/1500 UTC filament eruption. This is due to arrive around 06/1800 UTC, with the Likely result of a Minor or Moderate G1/G2 geomagnetic storm intervals and a Slight Chance of a G3 Strong geomagnetic storm, perhaps continuing into Day 2 (7th April).

In addition, a second centre-disc filament eruption, which was observed to peak around 04/2100 UTC, launched another, fairly weak CME. This has been analysed and shows a glancing blow at Earth on Day 4 (9th April), which may give a chance of a G1/minor storm.

Energetic Particles / Solar Radiation: The risk of further solar radiation storms should now slowly reduce as last week's highly active northwestern sunspot regions rotate further onto the far side. The residual risk from current front side groups is much lower given stable appearance. The high energy (greater than 2 MeV) electron flux may show a slight day-on-day increase in the short term, in the wake of recent fast wind influence. The chances of Active fluence are marginal through to day 1 (6th April), but again perhaps slightly more likely than not to occur. Flux levels may then be attenuated by the 03/1600 UTC CME arrival, which is currently expected to arrive at Earth on day 1 (6th April). Any recovery in fluence following this will probably be insufficient to breach Active.

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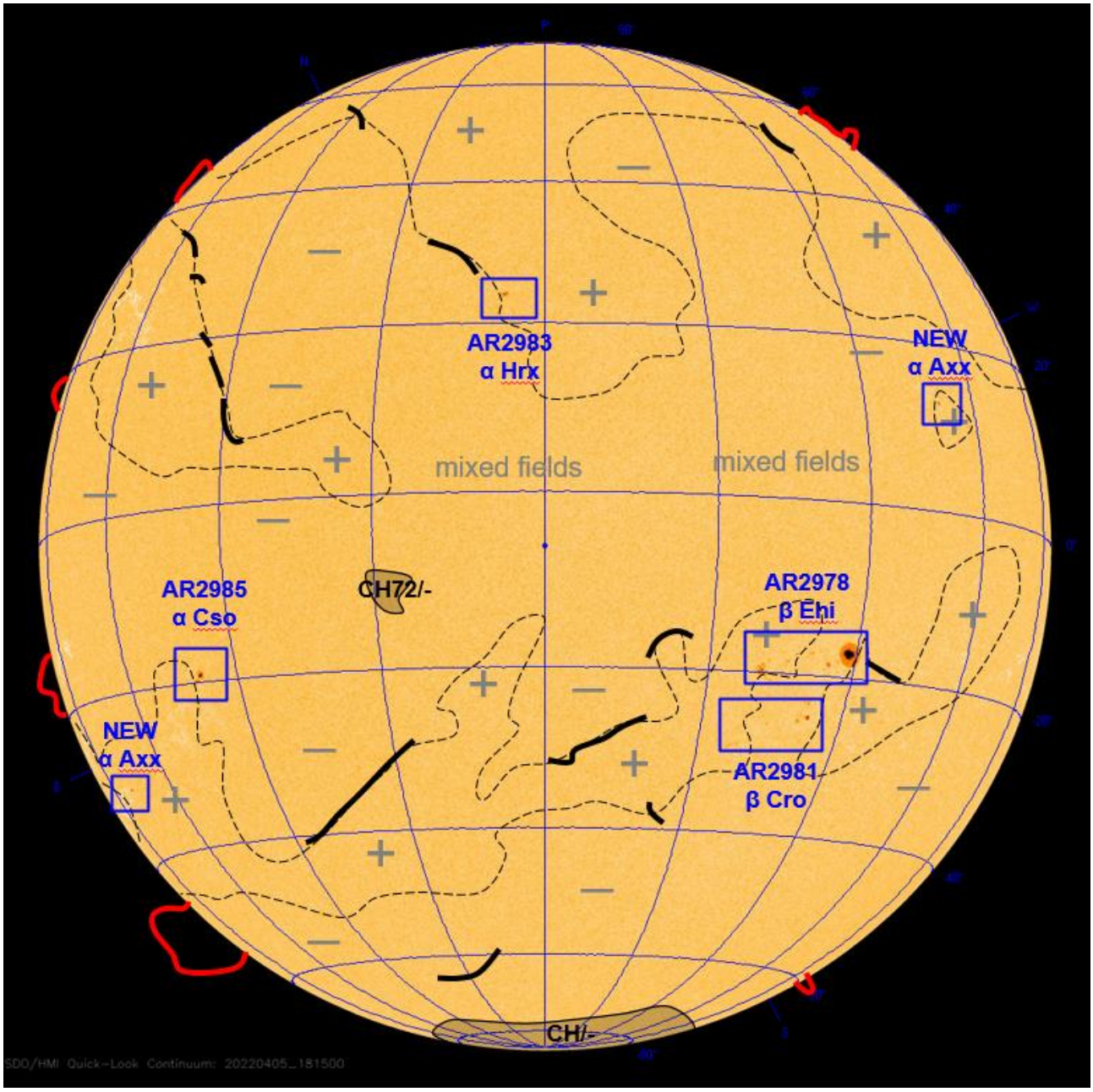
Figure 1. Solar Analysis Valid 05/1815UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Earth is currently exiting from a high speed stream from coronal hole(s) influences. The next coronal hole (CH72 in the eastern hemisphere) will possibly become geoeffective by Day 4 (9th April), combined with the arrival of a CME from the filament eruption on the 4th April.

There are currently two CMEs in the forecast.

The first CME originates from the 03/1500 UTC filament eruption. This is due to arrive around 06/1800 UTC, with the Likely result of a Minor or Moderate G1/G2 geomagnetic storm intervals and a Slight Chance of a G3 Strong geomagnetic storm, perhaps continuing into Day 2 (7th April).

In addition, a second centre-disc filament eruption, which was observed to peak around 04/2100 UTC, launched another, fairly weak CME, observed in coronagraph imagery. This has been analysed and shows a glancing blow at Earth on Day 4 (9th April), which may give a chance of a G1/minor storm.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	70	30	1	40
Strong	G3	No	5	2	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
03/2114	Full	Filament eruption	Centre-SW quadrant	595km/s	06/1800UTC	Onset after 06/1200UTC
04/2200	Partial	Filament eruption	Centre-SE quadrant	325km/s	09/1200UTC	Limited

Figure 2: MOSWOC Enlil shows the CME from the 3rd April arriving on Day 1 (6th April) – left imagine. A glancing blow from a CME launched on the 4th April arriving on Day 4 (9th April) – right imagine.

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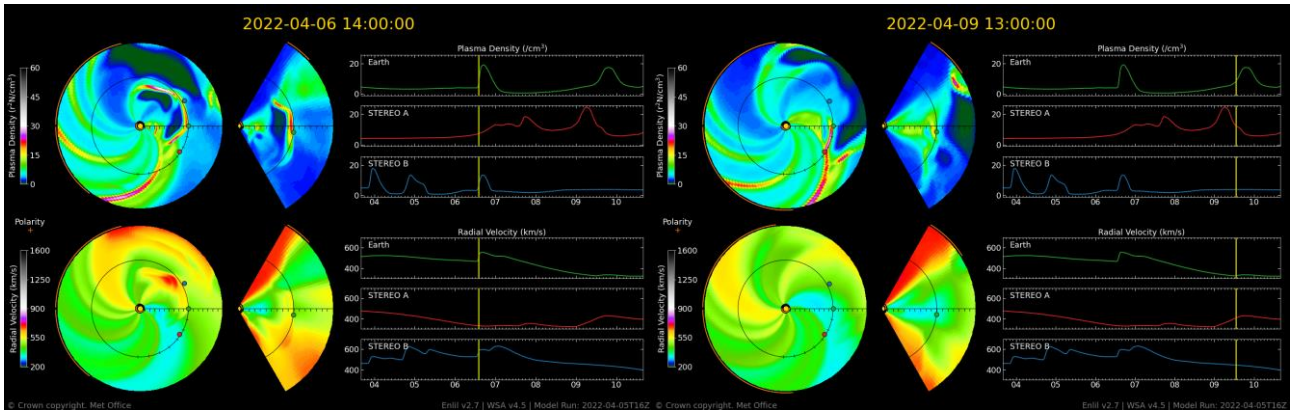
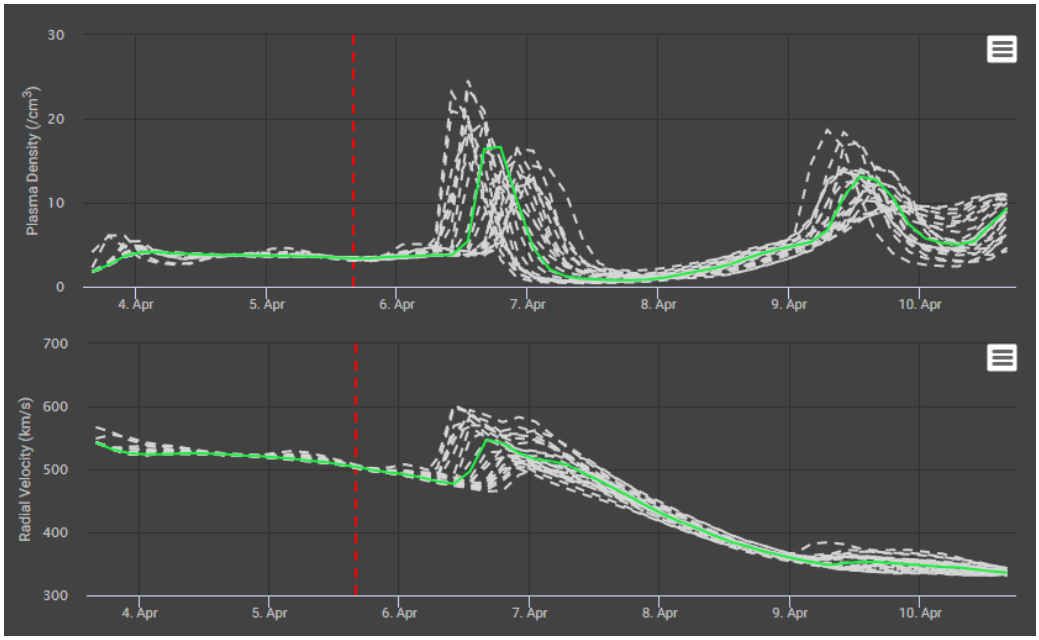


Figure 3: Enlils ensemble showing the spread in members for both CMEs, with the 9th April CME likely to be weaker compared to the 6th April transient.



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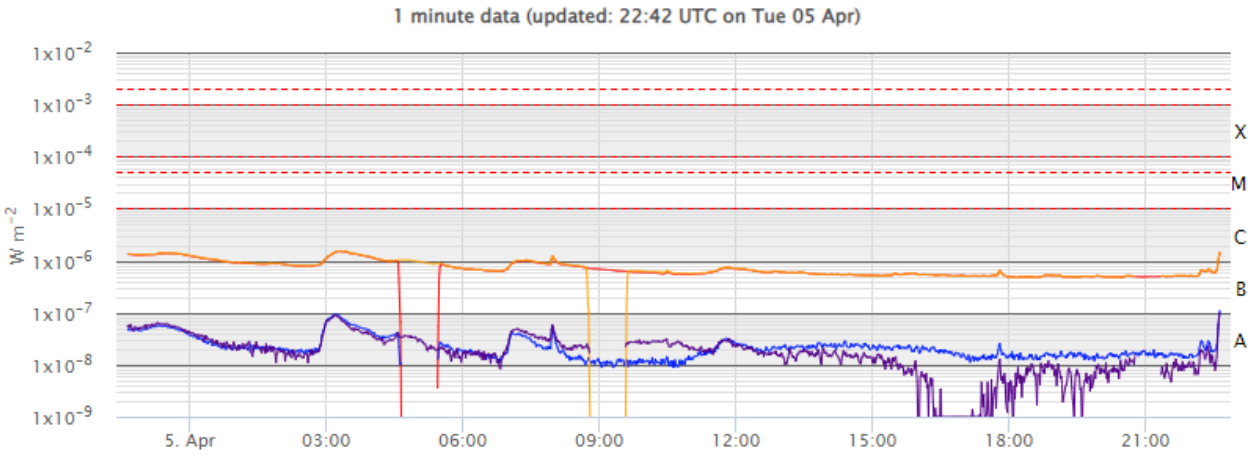
Radio Blackouts - X-Ray Flares:
The sun now appears to show an overall waning in X-ray activity, particularly given the departure from the Earth-facing side of Ex-AR2975 and to a lesser degree Ex-AR2976. This has left a disc populated by quiet unipolar groups and the large, but quiet and fading AR2978 and AR2981 near centre-disc.

There are some bright flux regions hinted at in STEREO A EUVI 195 imagery about to approach the eastern solar horizon. These may offset the departing regions to some degree, however these will be analysed in due course and do not yet feature in the forecast.

Overall, the chances of significant X-ray flares are much-reduced. M-class flares are rated at a daily Slight Chance throughout, largely the result of the raw potential of AR2978, although this has not been borne out in its activity, and the probabilities may yet be reduced further.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	15	15	15
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 4: GOES-16 X-Ray flares – shows only minor C-class flares in the past 24 hours.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is now well below the S1/Minor Storm threshold but remains slightly above resting background levels. This is expected to now very soon decline to its background state.

The source of all the recent S1 and near-S1 level enhancements (Ex-AR2975) rotated around the northwest limb late on Sunday 2nd April, and as such its contribution to the risk of further such events has now lessened.

The residual risk of S1 should then be inherited by the westward advance of the large but relatively subdued AR2978 and AR2981, perhaps offering a lower ongoing risk from day 2 (7th April).

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux showed a slight diurnal increase in its oscillation over the UTC day of Tuesday 5th April, reaching High flux levels, with a peak of 2900 pfu at 05/1625UTC. This is due to the waning influence of CH70 and exit from a high speed stream. The 24-hour integrated fluence showed a steady rising trend to just above the Active fluence threshold.
Electron flux should be muted over the coming due to the arrival of two CMEs, the first on Day 1 (6th April) and the second on Day 4 (9th April), with the overall risk of Active significantly reduced on a daily basis.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	10	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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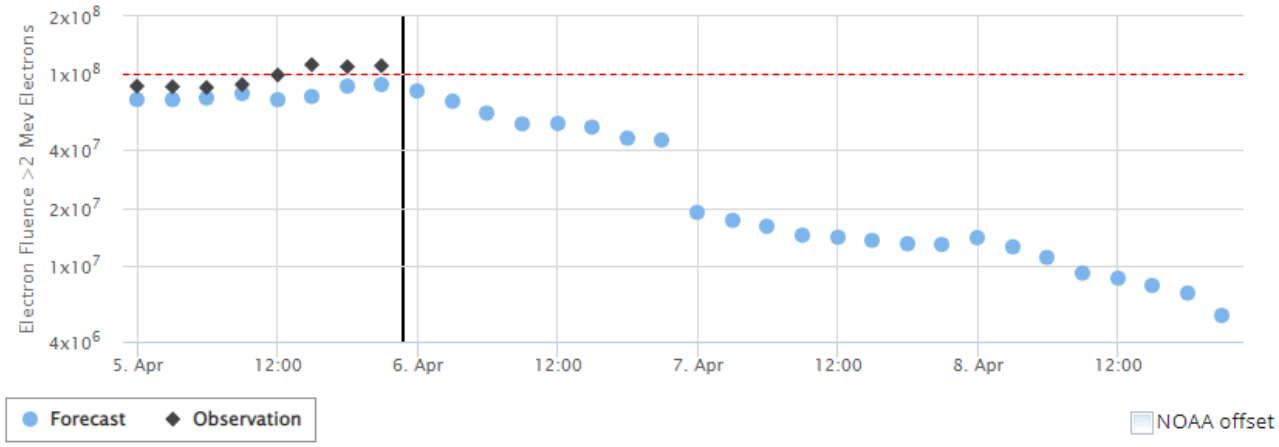
Figure 5: REFM Electron Fluence (observations and forecast) – currently above the Active threshold, but expected to decline to background with the arrival of CMEs and enhanced geomagnetic activity.



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